

# Real-Time Personalization in Dynamic Environments

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## **Abstract**

Real-time personalization engines can enable effective customization in E-commerce by finding the optimal offer for each customer. Yet, the development of such engines is not trivial. It remains challenging to optimize an offer strategy in real time, especially in a dynamic environment where the set of available offers varies over time. We provide a personalization engine to quickly learn, and serve, optimal context-dependent offers in a situation where the offer set may change over time. We formalize this personalization problem in the multi-armed bandit framework, and propose a new bandit algorithm boosted by the particle filtering estimation technique. Our method allows firms to flexibly introduce new personalized offers and calibrate their anticipated performance using historical data. We show in a news article recommendation setting that, relative to state-of-the-art competing methods, our method improves the click-through-rate by 3.7-6.5% and is computationally efficient.

**Subject Areas:** *Customer Relationship Management and Customer Satisfaction, Decision Support Systems, Recommendation Systems*

**Track:** Methods, Modelling & Marketing Analytics